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Skew-Quadrupole Combined-Function Magnets for a Muon Storage Ring*

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For Neutrino Factory Feasibility Study-II we have a new superconducting magnet design which makes compact muon storage ring arcs feasible. The design provides alternating gradient skew-quadrupole focusing, nearly continuous bending, and effectively no magnet ends for most of the arc. We use flat racetrack superconducting coils, above and below the circulating beam. The coils are longitudinally offset and surrounded by a warm iron yoke. In the region of full top and bottom coil overlap the dipole guide field is full strength with a small quadrupole gradient. Where there is no overlap the dipole guide field is half strength but there is an extra skew-quadrupole gradient for beam focusing. The sign of the skew-gradient depends upon whether the top or bottom coil is missing. Racetrack coils have an advantage in that they do not have complex bends and accommodate brittle superconductors, like reacted Nb_3Sn , so that high field strengths can be reached. The split coil geometry keeps superconductor out of the midplane and away from direct hits by decay electrons. Special attention is given to the optimization of the coil support structure and the mini-cryostat configuration.

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